



4th Neltume Ports Alignment Meeting

 **NELTUME PORTS**
Empowering Trade



Port Operation in a Changing Climate

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Agenda

1. Climate Projections
 1. Global impact
 2. LATAM impact
 3. Chilean Impact
2. Impact on Ports
3. Recommended Responses
4. Neltume Ports and the changing climate

Introduction



“The climate is changing. The evidence is unequivocal. Climate change represents a significant risk to business, operations, safety and infrastructure – and hence to local, national and global economies. However, a positive, proactive response, now and into the future, can both reduce these risks and bring business opportunities. Uncertainties remain, but these can be addressed and are not reasons for delay. It is time to reinforce the message and upscale prudent action.”

Extract from PIANC declaration on climate change

Main Institutions

The following institutions are steering climate change research on a global level

Available Literature

This presentation will focus on the climate change effect on the coastal environment, specifically: Ports. The following authors were identified as most relevant, describing the effect of climate change as well as the possible mitigation measures:

- ❖ Intergovernmental Panel on Climate Change (IPCC)
- ❖ United Nations: Economic Commission for Latin America and the Caribbean (UN:ECLAC or UN:CEPAL in Spanish)
- ❖ United Nations Conference on Trade and Development (UNCTAD)
- ❖ PIANC – the World association for Waterborne Transport Infrastructure



Economic Commission for Latin America and the Caribbean

1. Climate Projections



1. Climate Projections

Global and regional overview of possible impacts to the oceans

What will it take to stop the world from warming further than 1.5°C by 2050?

Human activities already caused a 1°C increase in global warming since 1890-1900.

According to IPCC (2018) we need to:

- ❖ Reduce the CO₂ emissions by **45% by 2030** (relative to 2010) AND then reach **nett-zero** CO₂ emissions by **2052** and **net-zero GHG** emissions by **2070**.
- ❖ **Net-zero** can only be achieved by innovation and implementation of CO₂ extraction and storing technology through global corporation

The current Paris Agreement will not achieve this and will still lead to the heating of the planet to 3°C by 2100.

What will happen to the ocean at a 1.5°C warmer planet?

(Projected changes that would impact coastal infrastructure and operations according to IPCC AR5 2019 and IPCC AR6 2021)

Sea Level Rise

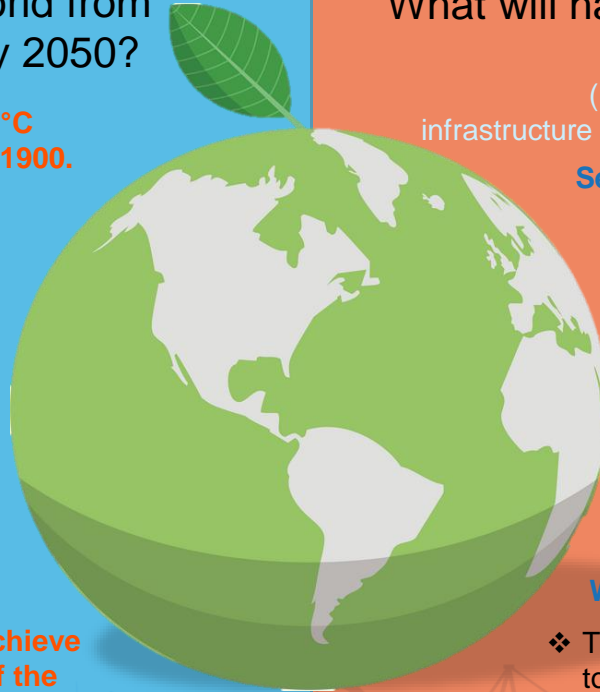
- ❖ **0.47 m by 2100** (SSP1-2.6 for range: 0.32-0.62 m)
- ❖ **0.82 m by 2100** (SSP5-8.5 for range: 0.63-1.01 m)

Extreme Events - Storms

- ❖ Significant wave height to increase in the Southern Ocean
- ❖ Centennial events likely to become annual events by 2050

Weather and Tides

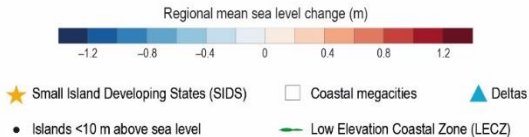
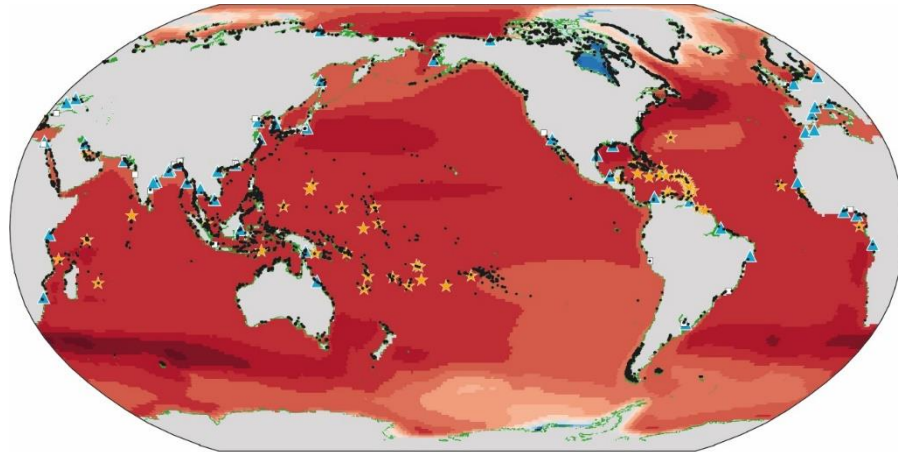
- ❖ Tidal amplitudes and patterns to change due to sea level rise
- ❖ Weather patterns to change



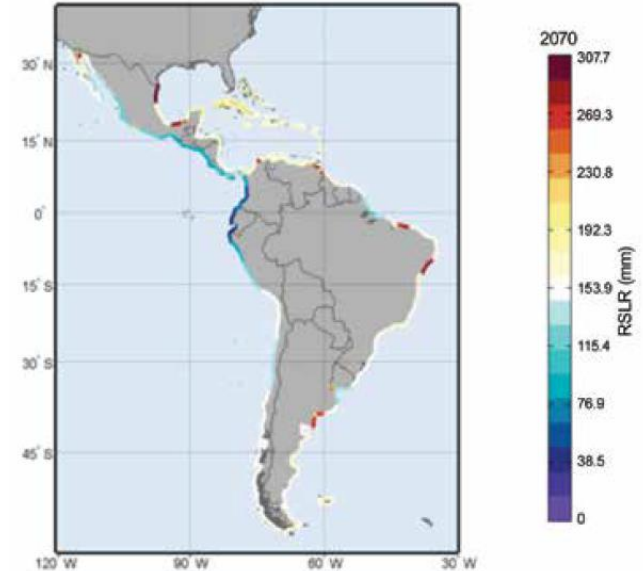
1. Climate Projections

Global and regional overview of possible impacts to the oceans Sea Level Rise

Models on a global scale (IPCC 2019) estimate an mean sea level increase of between 0,4 m to 0,8 m by the year 2100 as demonstrated below.



Source: IPCC 2019



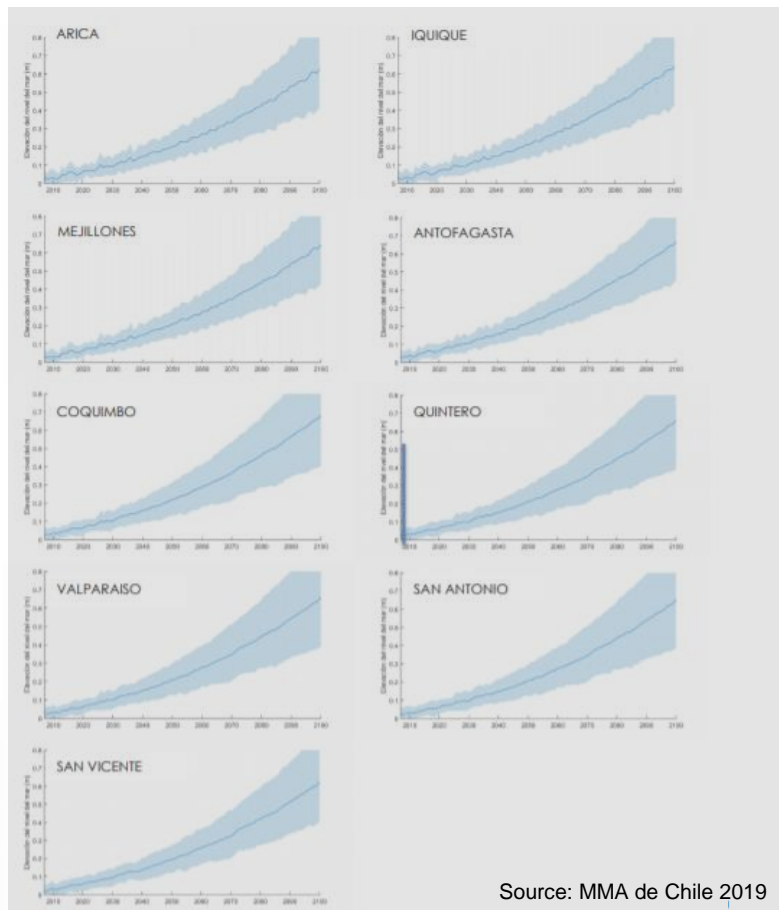
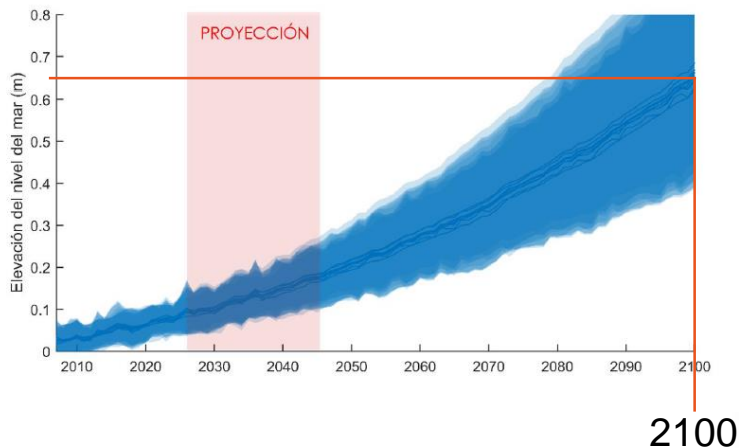
On a regional level, CEPAL (2015) estimated the mean sea level increase by the year 2070 will be in the range between 0,04 m and 0,2 m.

1. Climate Projections

Local overview of possible impacts to the oceans

Sea Level Rise

The Environmental Ministry of Chile adopted the projection that as a mid level estimate – by the year 2100, the Chilean ports will experience a rise in sea levels of 0,6 m to 0,7 m relative to 2010 levels.

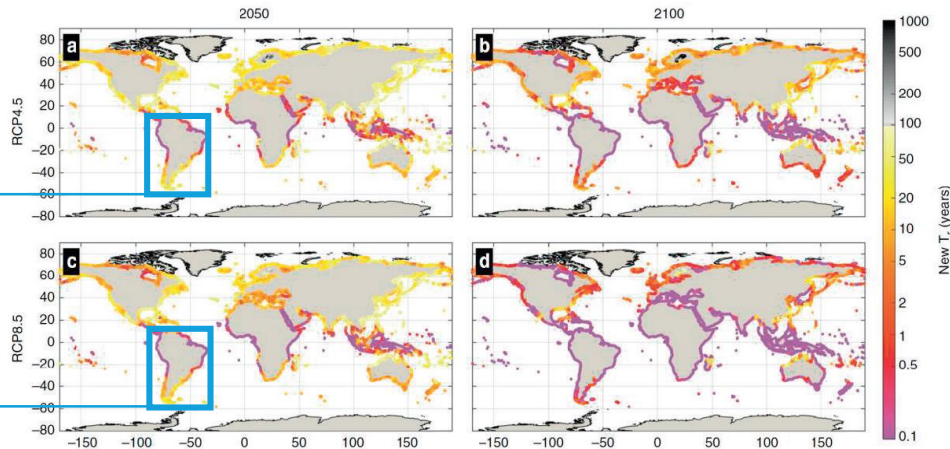


Source: MMA de Chile 2019

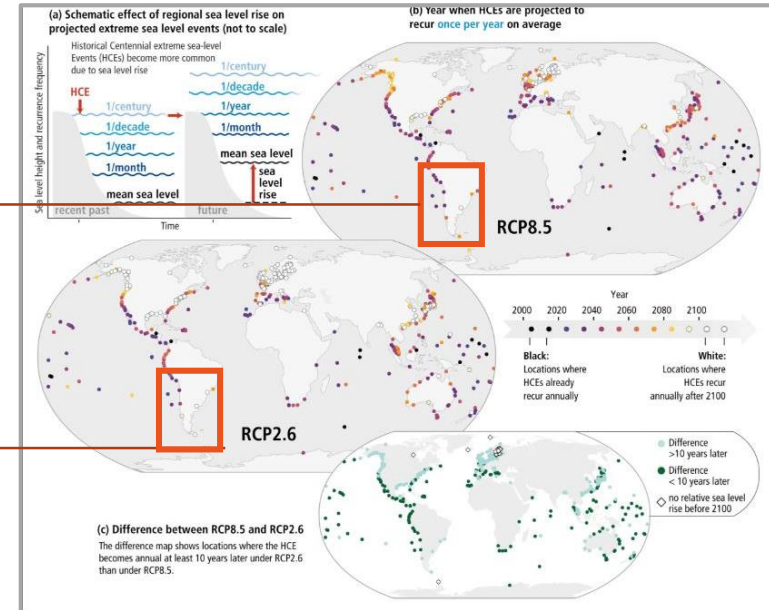


1. Climate Projections

Global and regional overview of possible impacts to the oceans Extreme Events



According to Vousdoukas *et al* (2018), the current **100-year Extreme Sea Level** west of South America for the medium and worse case scenarios (RCP4,5 and 8,5) – will have a return period of between **0,1 and 10 years** by 2050 and between **0,1 and 2 years** by 2100.

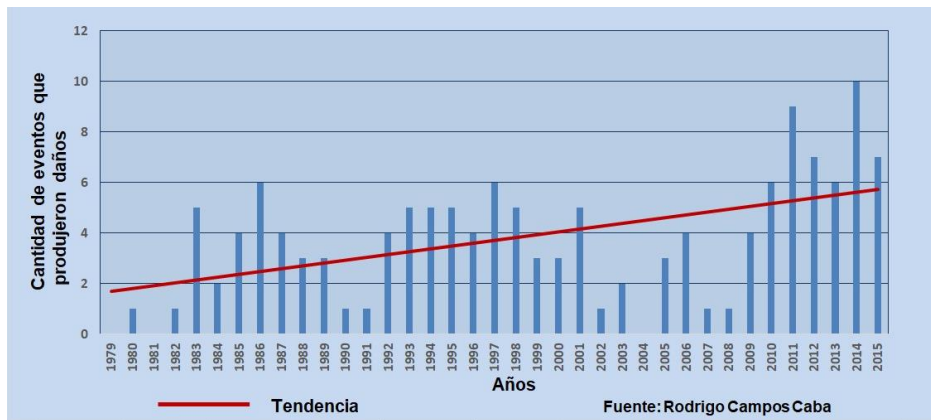


According to IPCC (2019) – For Chile, the **100-year Extreme Events** would become 1-year events by 2030-2040 – that means, more large and frequent storms in the coming decades, possibly causing more downtime.

1. Climate Projections

Regionally, positive trends have been observed in the number of storm events on the Chilean coast

Annual distribution of storm events that caused damage or impacts on the Chilean Coast, 1979-2015



Quantity of storm notices, 2006 - 2020



Source: Directemar 2020



2. Impact on Ports



2. Impact on Ports

Global overview of possible impacts to Ports

Foreseen Impacts on Ports



COASTAL
FLOODING

HEAVY
RAINFALL

HAZARD

IMPACT

Sea Level Rise

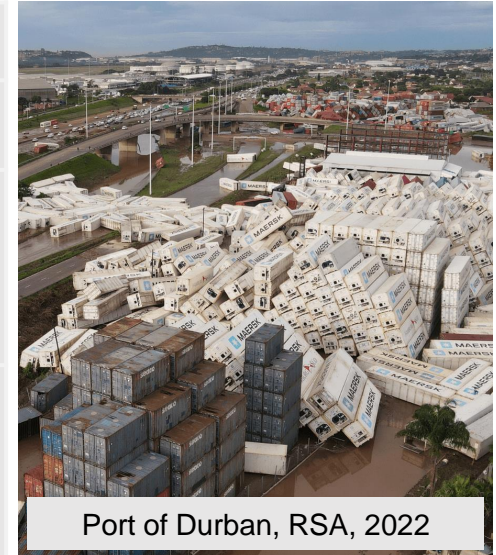
Risk of permanent inundation. Changes in port access. Major insurance issues.

Extreme Sea Levels – changes in wave energy/direction

Chronic flooding of infrastructure, damage to port facilities, losses due to operational delays, increased sedimentation, insurance issues, higher dredging requirements

Change in frequency and intensity of rainfall causing riverine and pluvial flooding or droughts

Manoeuvrability of vessels due sudden change in water level or speeds. Poor visibility from increased fog. Operational Delays.



Port of Durban, RSA, 2022

Source: (Asariotis, Kruckova and Mohos Naray, 2020)

2. Impact on Ports

Global overview of possible impacts to Ports

Foreseen Impacts on Ports



TEMPERATURE

EXTREME WIND
AND WAVES

HAZARD

IMPACT

Higher mean temperature, heat waves, droughts.

Personnel Safety. Deterioration of paved area, inoperable cranes, navigational equipment and cargo damage. Higher energy consumption for cooling.

Changes in frequency and intensity of extreme events.

Damage to terminals and navigational equipment, problems in vessel navigation and berthing with ports, problems with crane operations.

Source: (Asariotis, Kruckova and Mohos Naray, 2020)



Hurricane Ian, FL, USA, 2022

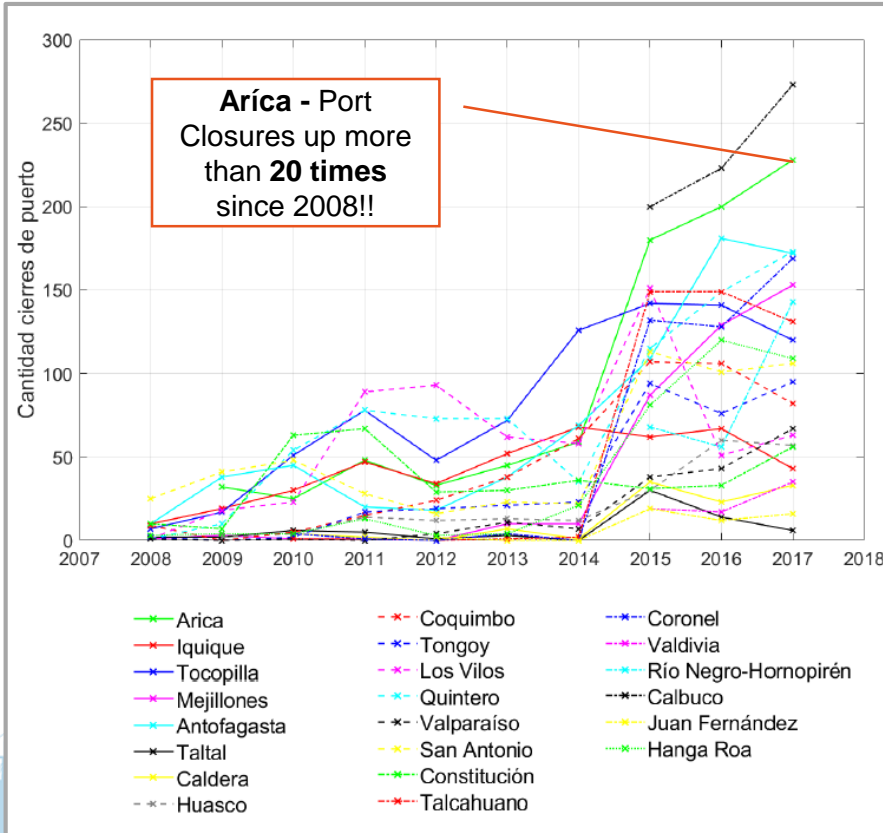


Valparaíso, Chile, 2015

2. Impact on Ports

Local overview of possible impacts to Chilean Ports

Number of Chilean Port Closures (2008 – 2017)



Downtime in selected Ports – San Antonio



3. Recommended Responses



3. Recommended Responses

Climate Change responses

International Literature: High Level

Climate Change response measures can be categorised in 2 main categories:

1. Mitigation
2. Adaption

The response category most applicable to Port Operators is the **Adaption** to Climate Change

Mitigation

- Emission Control
- CO2 Extraction
- Governmental Responses

Adaption

- Coastal Accommodation
- Climate Resilience Planning and Adaption
- Hard, Soft Engineering

Most applicable to us as Port Operators

3. Recommended Responses

Port Specific adaption responses



	PHYSICAL MEASURES	SOCIAL MEASURES
COASTAL FLOODING	<p>Reinforce and raise existing flood defences, relocation of critical assets, temporary flood defence, floating infrastructure</p> <p>Introduce new mooring technology, upgrade bollards/fenders</p>	<p>Training for installation of temporary flood defence, stacking procedures (using of empty containers as stack base)</p> <p>Monitoring, flood risk mapping, forecasting models, operational protocols, improve queuing procedures</p>
HEAVY RAINFALL	<p>Increase drainage capacity, maintain drainage infrastructure, raise elevation, flood defence structures.</p>	<p>Monitoring, flood risk mapping, Adverse weather planning, stacking procedures (using of empty containers as stack base)</p>
TEMPERATURE	<p>Use of heat resistant equipment on terminal, thermal efficiency of storage area.</p>	<p>Monitoring, adaptive management procedures</p>
EXTREME WIND AND WAVES	<p>Reinforce/upgrade existing infrastructure (e.g. breakwaters) upgrade bollards/fenders, increase tug pull capacity</p>	<p>Meteorological monitoring and forecasting, improve queuing procedures, minimise non operational times of vessels</p>



ShoreTension System, TPA

Source: PIANC 2019

3. Recommended Responses

Port Specific adaption responses

Case Studies

Climate Change adaption of various ports around the world were analysed and found to be in various levels of development. For the most part, these measures can be described as strategic planning frameworks that contains physical and financial risk assessments for the specific cases as well as future measures to adapt to the changing climate.

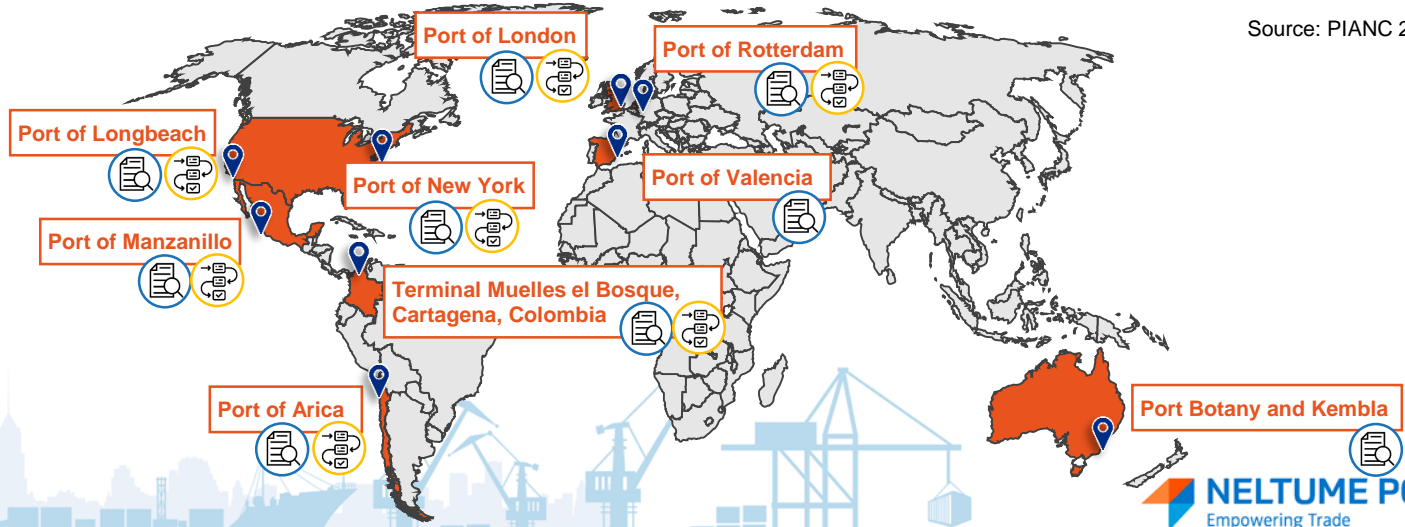
CLIMATE CHANGE ADAPTION EXAMPLES



Vulnerability Study: Contextualising the effects of climate change to the port limits



Adaption Planning: Identification and prioritisation of adaption measures



Source: PIANC 2020

3. Recommended Responses

Case Study: Terminal Puerto Arica has implemented various measures to ensure better operability

In 2016, TPA had a high downtime (25%), specifically for their berth 2B – where wave conditions in the harbour basin would cause excessive vessel movements and forces on the mooring lines, which would cause closure of the berth.

TPA has since then implemented various solutions which caused the improved operability of the port.

Solutions implemented:



Physical Measures



ShoreTension
2016



ShoreTension
2022



Social Measures



**New Pilot boat
and Tug vessels**
Increased wave height
for vessel manoeuvres



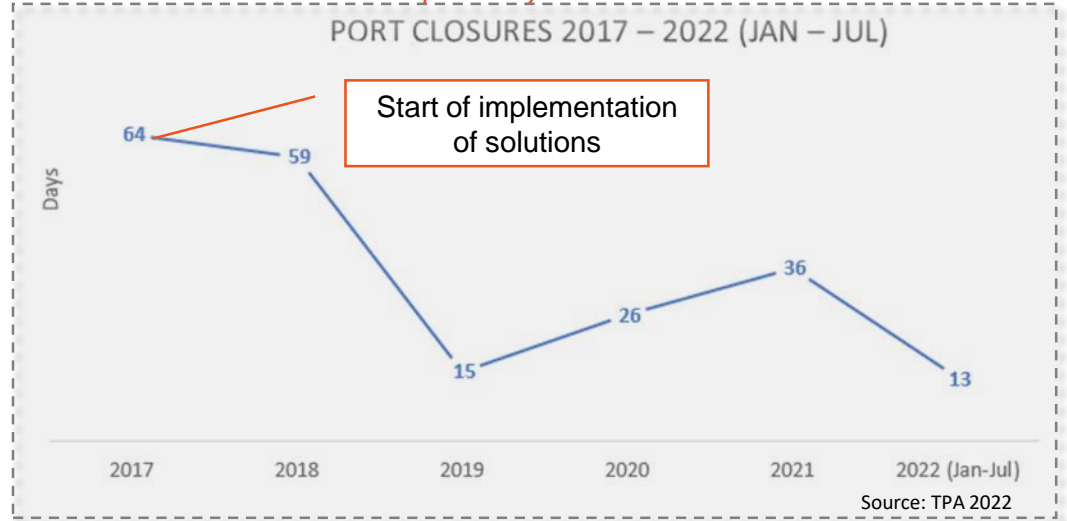
**Strategic
Planning**
Weekly meeting
with Pilots



**New Current
meter – Berth
5 and 2B**



Wave Dashboard
Real-time measurement
and climate forecast
system



4. Neltume Ports and the changing climate

INITIAL CONCLUSIONS FROM THE LITERATURE



4. Conclusions

Important conclusions from the literature

Changing Climate



- Climate change is observable and measurable – it is not something that is projected to happen.
- The maritime industry as a whole is particularly vulnerable to physical threats of climate change.
- **The impacts of climate change on the Port will likely fall into three categories: asset damage, cargo damage, and lost revenue due to facility closure/downtime.**

Response to Climate Change



- There are no silver bullet solutions in adaptation to climate change – it will be a conglomerate of a different solutions.
- These solutions will be region and port specific. Each port should contextualize the most relevant climate hazards and plan accordingly.
- **The best value for money adaption activity in the short term is improved monitoring and record keeping of disruption of port activities and analysing the data for any trends over time.**



Thank you!



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